110,378

PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

An Improved Process of and Apparatus for Refrigeration.

I, EDWARD CHARLES ROBERT MARKS, of 57 and 58, Lincoln's Inn Fields, London, W.C., Consulting Engineer, do hereby declare the nature of this invention (a communication to me from abroad by Isko Incorporated, a corporation organized under the laws of the State of Michigan, having a place of business at 1735, Mt. Elliott Avenue, Detroit, Wayne County, State of Michigan, United States of America, Manufacturers) and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to an improved process of and apparatus for refrigeration involving the compression of a refrigerant, and is primarily intended for use in domestic refrigeration.

A refrigerating car has been proposed which has a condenser on the roof thereof comprising a considerable length of double tubing exposed to air on the exterior of the outer tube and the interior of the inner tube, the refrigerant being passed through the annular space between said tubes.

The objects of the invention are to provide an inexpensive and improved method of cooling the refrigerant after compression thereof, and to provide an economical and simple construction of apparatus which may be easily and cheaply employed in domestic refrigeration and may be applied readily to existing refrigerator boxes.

The invention consists in a refrigerating apparatus comprising the combination with a refrigerator box having a refrigerating compartment, of an expansion coil located within said compartment, and a condenser mounted at the exterior of said box, said condenser consisting of a considerable length of single tubing in contact over its entire exterior surface with atmospheric air and cooled entirely by the action of such air, the condenser and expansion coil being connected together and to a suitable compressor.

The condenser may be in the form of a plurality of spaced loops surrounding the compressor and its driving means, so as to form a protecting cage around the same.

In one form of apparatus constructed according to the invention, the compressor and its driving means and the condensing coil are all mounted on the exterior of the upper wall of the refrigerator box with the coil arranged around the compressor and driving means in loops of approximately the same size as said upper wall.

The invention further consists in a refrigerating unit wherein a condenser freely exposed to the atmosphere, and a compressor and its driving means are all mounted upon a single support adapted to be mounted on a refrigerator box so that said parts are all located exteriorly of said box, and an expansion

coil connected to said condenser is also supported by said support in position to extend into said box through an aperture in the wall thereof, the support preferably being arranged to tightly close said aperture when applied to the box.

Refrigerating machines have been proposed having an enclosed rotary condenser dipping into cooling water, and a fan for circulating air over the wet condenser to assist in cooling the same. In one form of refrigerating car it was proposed to blow cold expanded air from a special refrigerant pump over a condenser located in a closed compartment of the car, and in another form of refrigerating car it was proposed to mount the condenser on the roof of the car, surrounding a number of pipes containing the cold expanded refrigerant, the air currents produced assisting said pipes in cooling the condenser. It has also been proposed to mount a compressor within a closed condensing casing on the exterior of a refrigerating box, which casing also supported the compressor driving means and the expansion coil, the latter extending into said box through an aperture therein.

In the accompanying drawings:—

Figure 1 is a view of a refrigerating apparatus built in accordance with this invention shown as applied to a domestic type of refrigerator, the latter being partly in section;

Figure 2 is a plan view of the refrigerator and apparatus shown in Figure 1;

Figure 3 is an enlarged sectional view through the condensing coil on the line 3—3 of Figure 2;

Figure 4 is a view on a still larger scale representing a cross section of the tubing forming the condensing coil;

Figure 5 is a perspective view of a unitary refrigerating apparatus constituting another form of the invention;

Figure 6 is a front elevation of the apparatus shown in Figure 5 as applied to a refrigerator of the domestic type, the refrigerator being shown in part, in vertical section;

In the form of the invention shown in Figures 1 to 4, 10 indicates a refrigerator which may be of any desired construction, and is shown as having a shelf 11 at the top to support an expansion coil 12. 13 indicates a compressor mounted on the top wall 311 of the refrigerator near one end thereof, and 14 a motor for driving said compressor mounted on said top wall near the other end thereof. 15 indicates a driven pulley adapted for the operation of the compressor. Said pulley is connected by one or more belts 16 to a driving pulley 414 on the shaft of the motor 14. Said belts are preferably round in section and both the driven pulley 15 on the compressor and the driving pulley 414 on the motor have suitable peripheral grooves to receive said belts.

The driven pulley 15 is made heavy so as to act also as a flywheel and preferably has spokes 17 constructed to form fan-like, helical blades which act to produce a circulation or draught of air over the top of the refrigerator and effect a continual change of the air in and about the apparatus thereon. The compressor and the motor, as shown, are mounted on a common, hollow base 18 which is attached by suitable bolts 19 to the top wall 311 of the refrigerator.

A condensing coil adapted for air cooling is indicated at 20. It comprises a considerable length of tubing, having a comparatively small cross section and a comparatively thin wall to obtain maximum cooling. I have found that the best results are obtained by using copper tubing of about $\frac{3}{8}''$ diameter. As shown the condensing coil is mounted above the refrigerator and it is exposed to the air throughout its length between the compressor 13 and the expansion coil 12. It comprises a plurality of vertically spaced, horizontally disposed loops 320 which surround the compressor and motor in the form of a cage, thus acting as a guard about the operating parts of the apparatus. In the drawings these loops 320 approximate in size and form to the plan of the top wall 311 of the refrigerator and thus occupy a maximum of horizontal space

without extending beyond the refrigerator and a maximum length of tubing is included in each loop. As many loops are used to make up the condensing coil as will be required to properly cool and liquefy the refrigerant and it is found that by the construction and arrangement described the loops will not need to extend any substantial amount above the top of the flywheel or pulley of the compressor, so that the apparatus as a whole will require a minimum height in the space that it occupies. At the same time, by making the condensing coil, as shown, of substantially the same plan as the top wall of the refrigerator and forming it of tubing of small cross section and of thin metal, a maximum of radiating surface is provided in the coil and air cooling is sufficient to efficiently condense and liquefy the refrigerant therein.

The plurality of loops are supported in any convenient manner, and, as shown, are attached to upright bars 21 located at the corners of the top of the refrigerator. Said loops are connected to said bars by means of plates 22, having a plurality of vertically spaced, semicircular parts 23 which engage the several loops and hold them in proper vertically spaced relation.

The top coil has an inlet end 24 which is led down and connected to the compressor in such manner as to receive the compressed refrigerant from the cylinder of said compressor. The bottom coil has an outlet end 25 which is led down through the top wall of the refrigerator and is connected by an expansion valve 26 to the inlet end of the expansion coil. 27 indicates the outlet end of the expansion coil which is led up through the top wall of the refrigerator and is connected to the compressor in a familiar manner.

By constructing the driven pulley on the compressor with the fan-like helical blade spokes as described, a proper circulation of air over and around said condenser or the loops of which it is formed is produced when, as is often the case, the refrigerator is placed under an overhanging shelf with its back against one wall and its two sides in close proximity to offsets in said wall.

By the arrangement of the condensing coil as described the rapidly moving parts of the apparatus are completely enclosed, so that no danger is incurred by those approaching the refrigerator.

Another form of the invention is shown in Figures 5 and 6. In this form a refrigerating apparatus is provided for direct application to any of the usual refrigerators by simply cutting an opening in the top wall of the refrigerator for the reception of the expansion coil, the parts of the apparatus all being carried by a single support so as to provide a unitary structure which may be readily applied to or removed from the refrigerator.

In Figure 6, 10 indicates a refrigerator as before, which may be of any suitable material and construction. As shown, the top wall 311 of said refrigerator is provided with an aperture or opening 28 therethrough.

29, indicates, as a whole, my improved unitary refrigerating apparatus. Said apparatus comprises primarily a base or support 30 which is adapted to rest upon the top wall of the refrigerator and to cover the opening 28 therein. The said base 30 is preferably made of wood and rectangular in form and generally longer than it is wide, and is provided on its bottom side with a sheet of felt or like material 31, which may be attached thereto in any suitable manner. Said felt effectually seals the interior of the box and absorbs any vibrations which might occur, thus reducing to a minimum the objectionable sounds which might be caused by vibration due to the moving of the various parts.

Mounted on the base 30 and toward one end thereof is located an upright compressor 32 fixed to a block or standard 33 which is rigidly attached to said base 30. Near the other end of said base is located a motor 34 for driving said compressor. 35 indicates a driven pulley adapted for the operation of the compressor 32, which pulley is operatively connected by means of one or more belts 36 to the motor 34. Said pulley 35 is of comparatively large diameter, and to accommodate the same a pit 37 is formed in the base 30 in the vertical plane of said pulley into which the bottom of the pulley extends.

20, indicates, as a whole, the condensing coil, made as before, of tubing of a comparatively small cross-section and of a comparatively thin wall, and comprising a plurality of vertically spaced, horizontally disposed loops 320, which approximate in size and form to the plan of the base 30. Said loops occupy a maximum of horizontal space without extending beyond the edges of said base.

The loops may be supported from the base in any suitable manner, but, as illustrated, are attached to upright bars 38 located near the corners of the base 30 on the outside of said coils at the corners thereof, the lower ends of said bars being bent to form feet by means of which said bars are attached to said base 30. The loops are held in supporting engagement upon the bars 38 by means of second bars or stops 39 located on the inside of said coil at the corners thereof, adjacent the upright bars 38 and attached to said bars in any convenient manner.

The top loop 320 of the coil 20 has an inlet end 24 Fig. 5 which is connected to the discharge side of the compressor 32 in such manner as to receive the compressed refrigerant from the cylinder thereof. The bottom loop 320 of the coil has an outlet end 25 which is arranged to extend through an aperture 40 formed in the base 30 near that end upon which the compressor is mounted and is there connected by means of an expansion valve 26 to the inlet end of the expansion coil. Interposed between the outlet end 25 of the condenser coil 20 and the inlet end 24^a of the expansion coil 12, is a by-pass pipe 41 in which is located a high pressure safety valve 42 which valve is designed to open under predetermined pressure in the condenser coil to allow passage of refrigerant to the expansion coil, and thus relieve the condenser coil of a pressure higher than that at which it is designed to operate.

The expansion coil 12 is located in a plane below the base 30 and preferably under that end of the base upon which the compressor 32 is mounted and is arranged in a plurality of vertically spaced series or nests 213, 214 and 215. Each nest comprises a plurality of horizontal, alternately arranged layers of W-shaped loops of pipe, the lowermost layer of pipe in each nest or series being connected to the uppermost layer of pipe in the adjacent series below. The lowermost layer of pipe of the nest or series 215 is connected at its outlet end to an upright pipe 216 which extends through a second aperture 217 formed in the base 30 and said pipe 216 is connected at its upper end to the inlet side of the compressor 32. In plan, each series or nest is made rectangular in form as shown in Figure 5 of the drawings.

The series or nests of pipe 213, 214 and 215 of the expansion coil are supported from the base 30 by means of a plurality of vertically arranged bars 43 which engage the outside surfaces of the corners of each of said series or nests and said bars 43 depend from and are attached to the base piece 30 by means of angularly extending feet 44. Arranged to engage the inside surfaces of the corners of each nest or series and co-acting with said bars 43 to support said nests or series is located a plurality of second bars 45 which are suitably attached at spaced intervals to the bars 43 in any convenient manner. The lowermost series of coils 214 and 215 are arranged to support upon each upper layer thereof a plate 46 in which is formed cup-shaped depressions 47, in which is placed drinking water to be frozen to ice, which ice is adapted for table use. Said depressions may be made in any desired shape or form so that the water therein when frozen will partake of the shape or form thereof.

Should it be so desired, a thermostatic control device may be added to this form of the invention, so arranged that when a certain predetermined low temperature has been reached within the interior of the box in which the expansion coil is located, the motor operating the system will be stopped through the action of said thermostatic control device such as shown at 48, and when the temperature within the refrigerator has reached a predetermined high degree, the motor, through the thermostatic control device 48 will be again started,

thus putting the system into operation. Such thermostatic control device 48 is shown as mounted upon one of the bars 43 so as to be under the influence of the temperature within the refrigerator.

I may also find it preferable to have as a part of my unitary system, a safety motor load control switch box 49, which may be conveniently located upon the upper surface of the base 30 between the motor and the compressor. This switch control is arranged to prevent burning out of the motor armature under the resistance imparted thereto during the starting of the compressor. Said switch box forms a convenient location for the main starting switch 50, said switch being suitably connected with the main source of current for operating the motor.

My unitary refrigerating apparatus is intended especially for use with sulphurous acid (SO_2) as the refrigerant as is also the case with the first form described. Such refrigerant, on account of its low boiling point, may be more easily condensed and liquefied by air cooling without the use of cooling water. My apparatus provides a large superficial area in the condensing coil so as to furnish the necessary amount of radiation and at the same time provides such a condensing coil in connection with the other parts of the apparatus that the whole refrigerating system may be mounted upon one common base. It will of course be understood that the apparatus is capable of use with other refrigerants.

It is apparent from the foregoing description of Figures 5 and 6 that the refrigerating apparatus constitutes a refrigerating unit complete in itself and which may be applied to any ordinary domestic refrigerator. All that is required is to provide an opening in the top wall of the refrigerator of a size permitting the expansion coil with its supporting bars to be inserted therethrough. When the unitary system is placed in the position described upon the top wall thereof, with the expansion coil within the refrigerator, the felt pad 31 effectually seals the interior of the refrigerator from the outside atmosphere. The switch mechanism is then connected to the ordinary electric light socket or drop cord, and the device is ready to operate.

From what has been said it will be manifest that in the process carried on in either of the forms of apparatus described, the refrigerant fluid, such as sulphurous acid (SO_2) is compressed by the compressor into the condenser in the usual manner and that the fluid is condensed and liquefied in said condenser entirely by the cooling action of the atmospheric air surrounding the same. From the condenser the fluid is admitted to the expansion coil by the expansion valve and is expanded to produce the refrigerating effect, the refrigerant being returned from said coil to the compressor.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A refrigerating apparatus comprising the combination with a refrigerator box having a refrigerating compartment, of an expansion coil located within said compartment, and a condenser mounted at the exterior of said box, said condenser consisting of a considerable length of single tubing in contact over its entire exterior surface with atmospheric air and cooled entirely by the action of such air, the condenser and expansion coil being connected together and to a suitable compressor.

2. An apparatus as claimed in Claim 1, wherein the condenser is in the form of a plurality of spaced loops surrounding the compressor and its driving means, so as to form a protecting cage around the same.

3. An apparatus as claimed in Claim 1 or 2, wherein a fan is located adjacent the condenser, or within the cage formed by the loops of the condensing coil, in order to create a circulation of air over and around said condenser loops,

the fan blades being formed, if desired, integrally with the compressor fly wheel.

4. An apparatus as claimed in Claim 2 or 3, wherein the compressor and its driving means and the condensing coil are all mounted on the exterior of the upper wall of the refrigerator box, the condenser being in loops of approximately the same size as said upper wall, the loops of the coil preferably extending to substantially the same height as the highest part of the compressing apparatus, and preferably being supported by members mounted on said wall and arranged to hold said loops in properly spaced relation.

5. In a refrigerating apparatus as claimed in Claim 1, mounting such condenser and the compressor with its driving means upon a single support adapted to be mounted on a refrigerator box so that said parts are all located exteriorly of said box and an expansion coil connected to said condenser is also supported by said support in position to extend into said box through an aperture in the wall thereof, the support preferably being arranged to tightly close said aperture when applied to the box.

6. The improved process of and apparatus for refrigeration, substantially as described with reference to the accompanying drawings.

Dated this 13th day of October, 1917.

MARKS & CLERK.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1917.

[This Drawing is a reproduction of the Original on a reduced scale.]

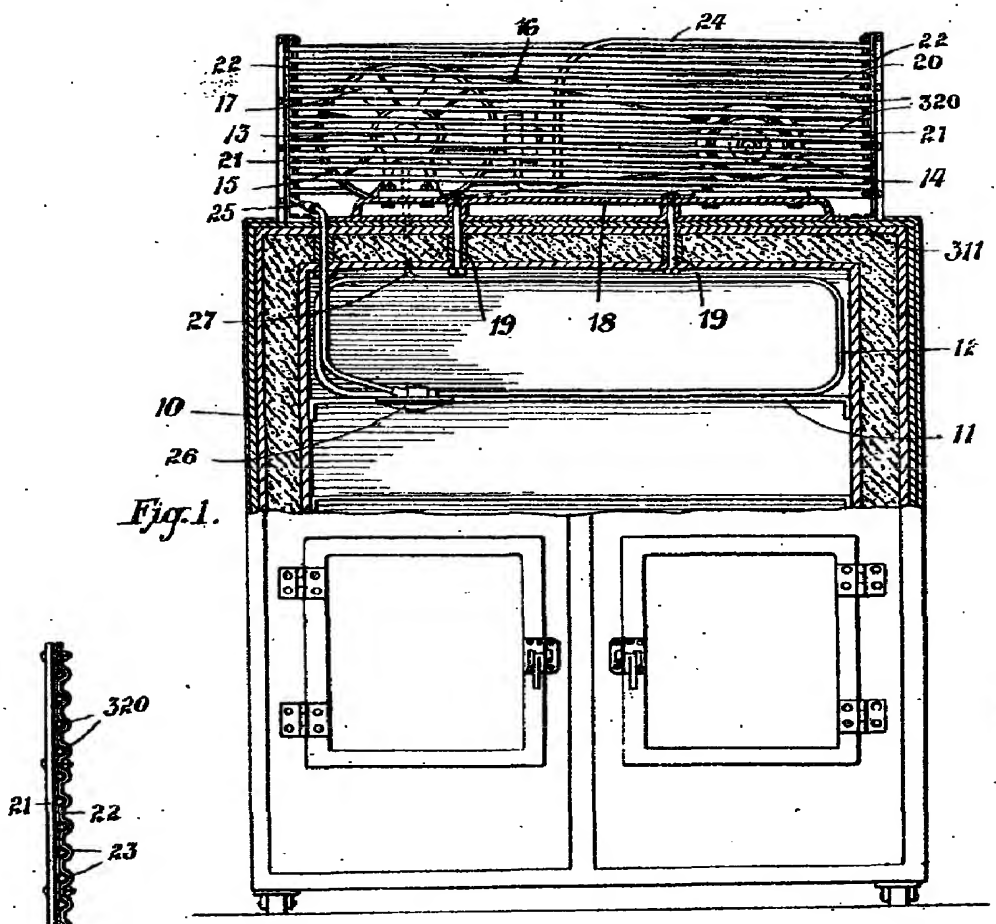


Fig. 1.

Fig. 3.

Fig. 4.

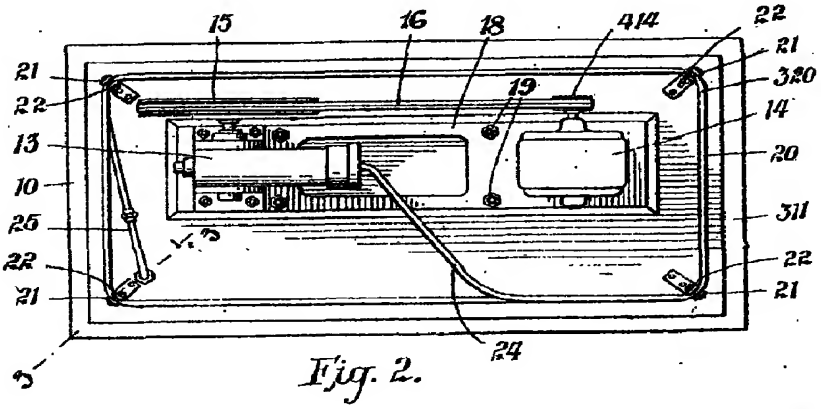


Fig. 2.

SHEET 2.

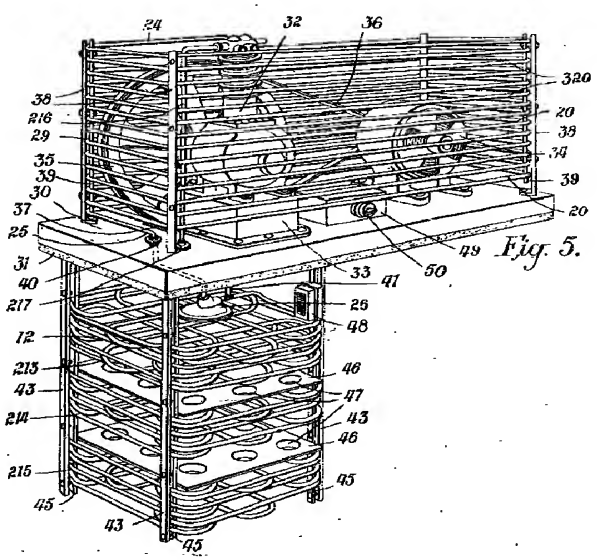
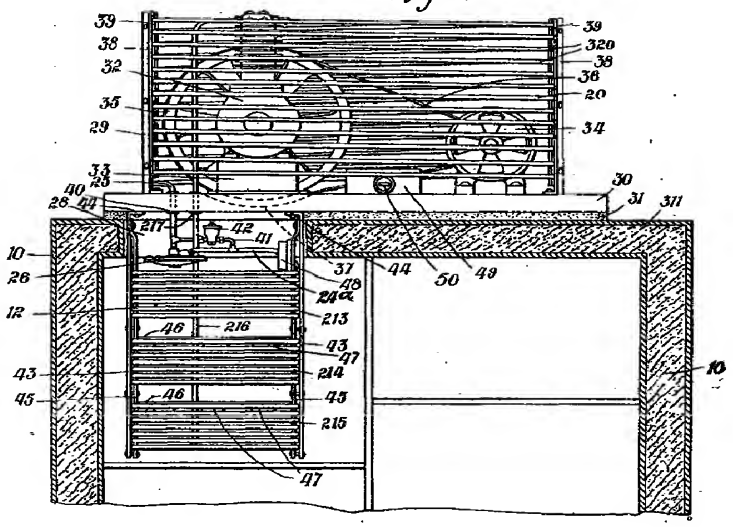


Fig. 5.

SHEET 3

Fig. 6.



SHEET 2.

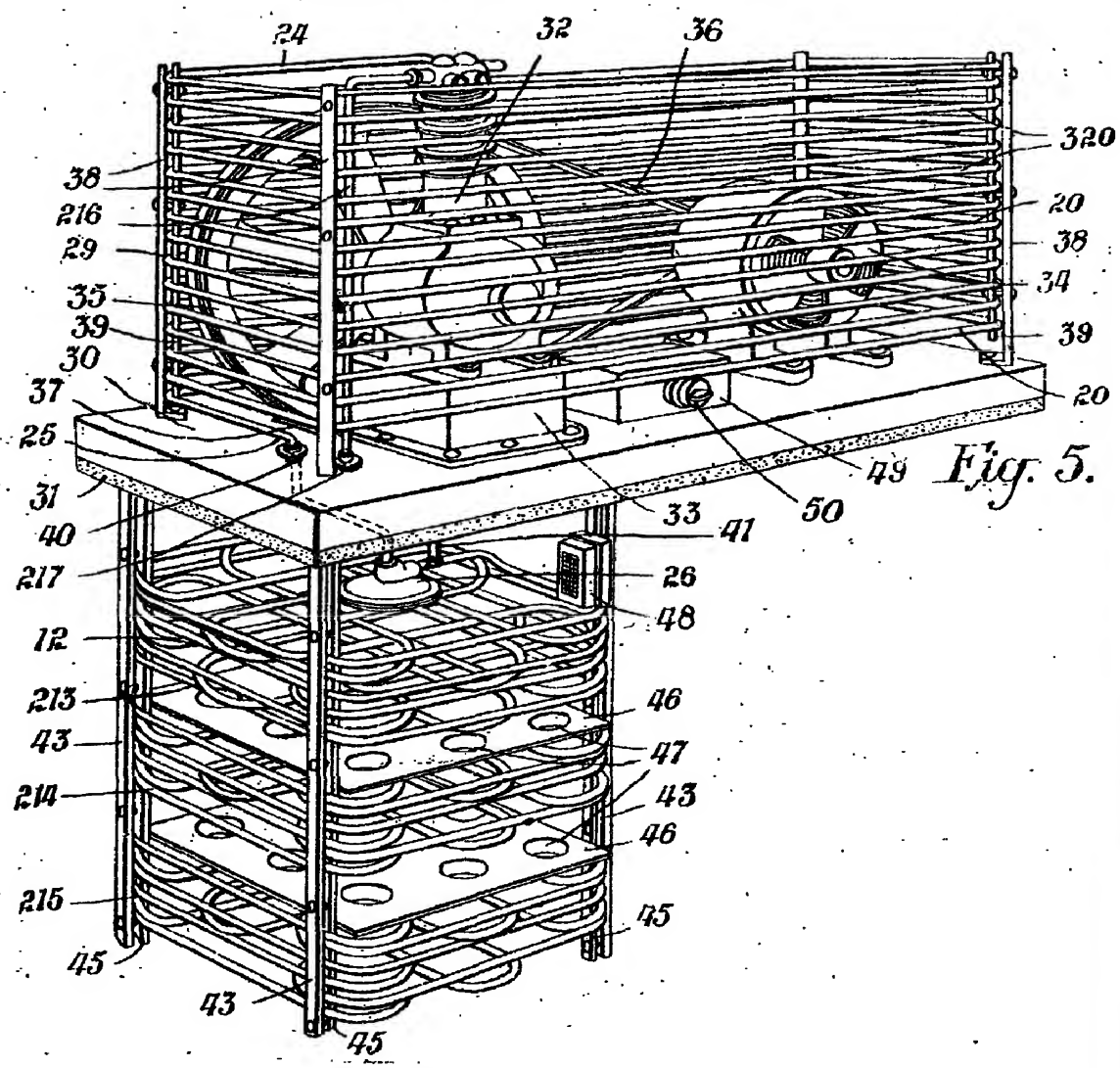
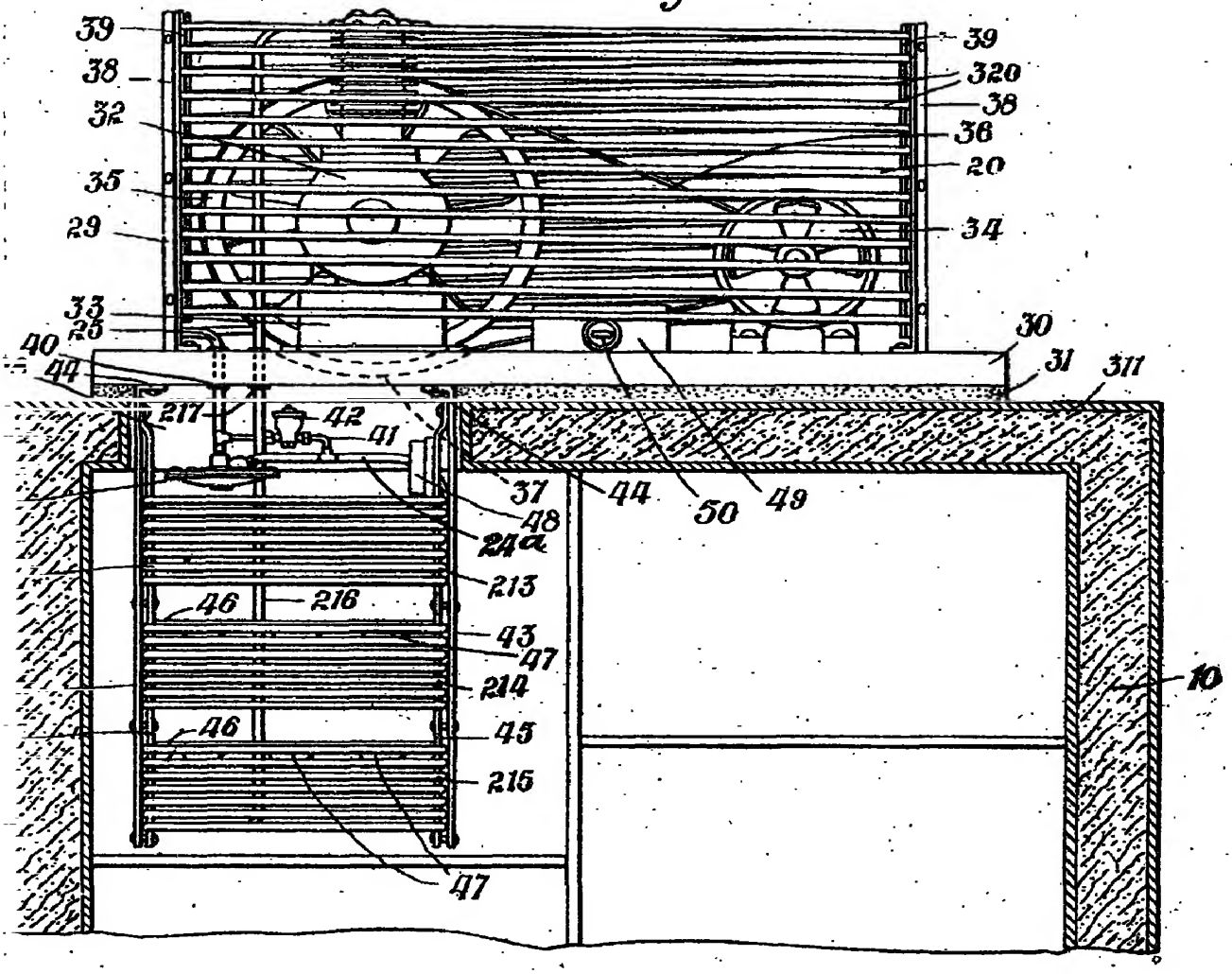


Fig. 5.

[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 6.



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